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ashes which cover the cone. Since these lavas are similar to those found in the crater, the authors regard them as vestiges of the latest flow, from which the areas connecting them with those above have been removed by erosion. The lineal character of the ridges, however, and their prominence, seem to the writer sufficient evidence for regarding them, as is usually done, lateral outbursts through the side of the cone.

The work is illustrated by several fair plates giving sketches of portions of the volcano. The employment of photographs for purposes of illustration would have been, however, more satisfactory.

OLIVER C. FARRINGTON.

RECENT WORK ON THE CARBONIFEROUS OF KANSAS.

Stratigraphy of the Kansas Coal Measures, by ERASMUS HAWORTH, Kansas Univ. Quart., Vol. III, pp. 281-295, 1895.

Classification of the Upper Palæozoic Rocks of Central Kansas, by CHAS. S. PROSSER. Journal Geology, Vol. III, pp. 682-705 and 764-800, 1895.

Permian System of Kansas, by F. W. CRAGIN. Colorado College Studies, Vol. VI, pp: 1-48, 1896.

A generation ago the upper Carboniferous succession in Kansas was the subject of prolonged and oftentimes somewhat acrimonious discussion. Since the close of that memorable debate there has been until very recently very little investigation undertaken in the state. So, for more than a quarter of a century practically nothing has been done to clear up the doubt concerning the question of the natural subdivisions of the Carboniferous system of that region; and for the same period little attempt has been made to decipher the stratigraphy of the formations which constitute the whole eastern third of the state.

Of late, within a few months of one another, three important memoirs have appeared which have greatly extended our knowledge of the stratigraphy of the region. These contributions, primarily to Kansas geology, are by Dr. Erasmus Haworth, Professor Charles S. Prosser, and Professor F. W. Cragin. The work along the three lines being undertaken without regard to one another the results are in no way directly connected. While this method of treatment has the

advantage of giving conclusions which have been reached independently it lacks the greater completeness which would have existed had the work been compared and adjusted in advance to publication. Through the details given the advancement of the whole subject is such as will enable a rational classification of the strata to be outlined with little fear that any radical departure will be necessary in the future. The results are not only important as regards the state of Kansas but they are especially valuable in pointing out more accurately than ever before the stratigraphical relations between the Carboniferous rocks of that state and those of Missouri and Iowa. The Kansas work supplies the information heretofore lacking which enables the geological history of the whole Western Interior coal province to be made out with a reasonable degree of satisfaction. The most important point of all however is that the three papers furnish the facts which until now have been needed to outline a rational classification of the Carboniferous deposits of the Mississippi basin. The main subdivisions are so clearly defined over the whole Western Interior regions that it becomes a matter of surprise and even wonderment that so many other and diverse lines of demarkation should have been selected. The systematic arrangement of the main subdivisions of the Carboniferous is now practically the same in Iowa, Missouri, Nebraska, Kansas, Arkansas, Indian Territory and Oklahoma ; and hence forward these states can have a uniform nomenclature so far as the upper Palæozoic formations are concerned. The minor stages of each of the major subdivisions or series differ in different localities. They will probably have to be established separately in each of the several states. Local members have already been named for the greater part of Kansas and the number and limits of similar local formations have not been entirely neglected in other parts of the province.

As the outcome of the recent work, and other late investigations of which special mention need not be made at this time, the Carboniferous of the Continental Interior appears to be separable into four principal sections or series. In a general way these correspond essentially with the four old subdivisions: the Lower Carboniferous, Lower Coal Measures, Upper Coal Measures, and the Permian. While the old and new lines of separation have approximately similar positions they do not coincide. Moreover the old lines were vague, different in the different states and even in different parts of the same state. The new lines are sharply defined in all particulars. In the field they are

easily distinguished by their lithological characters and the features which they impart to the physiography. Stratigraphically and faunally they are equally well marked.

Between the lowest of the four series, the Mississippian limestone, and the lower or productive Coal Measures, composed chiefly of argillaceous shale and sandstone, the separation is everywhere distinct. Limiting the shales above and forming the base of a series of more open sea deposits, known as the upper Coal Measures, is the Bethany limestone, of which the Erie or Triple limestone of Kansas and the Winterset limestone of Iowa are equivalents. In the field the thick limestone forms a more or less well-defined eastward facing escarpment from north-central Iowa through Missouri and Kansas to Indian Territory. The uppermost member of the upper Coal Measures is also a limestone with characteristic features. It has been traced from southeastern Nebraska across Kansas into Oklahoma. These three lines separate with remarkable clearness the great body of strata of the western Mississippi basin, which lie between the Devonian and the Cretaceous. A wealth of information is now at hand by which the four series can be fully described in accordance with modern rules of nomenclature: the geographic distribution, the stratigraphic position, the lithological character and the biological definition of each is capable of exact consideration.

Of the three articles, that by Dr. Haworth treats of the second and third great subdivisions, that of Professor Prosser the third and fourth, and that of Professor Cragin chiefly the fourth or uppermost.

Professor Haworth's paper is a summary of a fuller account of the stratigraphy of the Kansas Coal Measures that is to appear soon. The formation of the lower Coal Measures to which local names are given, are, beginning at the base, the Cherokee shales, Oswego and Pawnee limestones and the Pleasanton shales. The total thickness is regarded as 800 feet. In the upper Coal Measures are: the Erie or Triple limestone, Thayer shales, Iola limestone, Lane shales, Garnett limestone and Lawrence shales. Above the latter are the Oread, Lecompton, Topeka and other limestones up to the Cottonwood limestone. These are separated by beds of shales of greater or less thickness which, with two exceptions, are not named. The aggregate thickness of the upper Coal Measures is placed at 1950 feet.

The formations of the lower Coal Measures and of the lower half of the upper Coal Measures appear to be well defined. The exact deter

mination of the formations of the upper half of the upper Coal Measures has been reserved for subsequent consideration. The summit of the upper Coal Measures is placed some distance above the top of the Cottonwood limestone. "The divisions between the Permian and the Coal Measures has not been located definitely and will probably be placed not more than 100 feet above the Cottonwood Falls limestone, as the palæontologic evidence upon which such a division must depend seems to show that the greatest change of marine invertebrate life occurs not long after the formation of the existing fossiliferous shales lying above the Cottonwood Falls rock."

Paragraphs are given on the ratio of the limestone to shale and sandstone, on the characteristics of the limestones and sandstones, on the inclination of the strata, on the origin of the shales and on the general conditions of deposition. Two subordinate papers are attached which are in reality parts of the one under consideration. The first is on the division of the Kansas Coal Measures and the other on the coal fields of Kansas, in which are described the stratigraphical locations of the various coal beds in the different formations. There is also a consideration of the physical and chemical properties and the commercial values of the coals.

Although no special review of Professor Prosser's contribution is here necessary, as it appeared in the *JOURNAL OF GEOLOGY*, it should be mentioned for the sake of completeness. The most important feature perhaps, is the determination of the line of separation between what has been heretofore called the Upper Coal Measures and the Permian, the horizon selected being the fossil-bearing shales lying immediately over the Cottonwood limestone. The various subordinate formations are very clearly defined and fully described.

In Professor Cragins' account of the Permian system of Kansas a number of new names are proposed. Although Professor Prosser's work is noted and some quotations made it is not clear just what the relations are of the subdivisions proposed by the two authors. The following is the scheme suggested :

Cimarron Series.

 Kiger division.

 Big Basin sandstone.

 Hackberry shales.

 Day Creek dolomite.

 Red Bluff sandstones.

 Dog Creek shales.

Salt Fork division.

Cave Creek gypsums.

Flower-pot shales.

Cedar Hills sandstones.

Salt Plain measures.

Harper sandstones.

Big Blue Series.

Summer division.

Wellington shales.

Geuda Salt measures.

Flint Hills division.

Chase limestones.

Neosha shales.

A statement of particular significance and interest is that "In the past four decades geologists have repeatedly shown that the passage from the Carboniferous to the Permian system in Kansas is gradual and includes an interval of so-called Permo-Carboniferous rocks which combine the faunæ of both systems. The evidence of continuity and the question of the proper disposal of these intermediate rocks have led to much difference of opinion, some even having gone to the extreme of abandoning the Permian as a system of age, merging it in the Carboniferous, in attempting to avoid the difficulty of the situation. The Permian in America, is, however, a great and widely distributed system, difficult of diagnosis, though it may often be, from paucity of palæontological data. It is finely developed in Texas, where it has great thickness and has been found to have occasional fossiliferous horizons to within less than 300 feet of its summit. The Permian of the Kansas-Oklahoma basin undoubtedly has many similarities to that of Texas, but it is probably on only one or two of the terranes of the upper Permian, especially in the medicine lodge gypsum, that stratigraphic continuity or even parallelism of physico-geographic conditions can be traced between them. It therefore seems necessary to treat the Permian north and south of the Ouachita mountain system as belonging to two distinct basins, and profitless to attempt divisional correlation between them."

CHARLES R. KEYES.

Wissenschaftliche Ergebnisse der Finnischen Expeditionen nach der Halbinsel Kola, pp. 857 and numerous plates and maps, Helsingfors, 1890-92.

The expeditions referred to in the title were sent out by the Finnish Society of Botany and Zoölogy, the University of Helsingfors and some